



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

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M E M O R A N D U M

March 29, 1985

To: Myron Saikewicz and Harold Porath
From: Marc Heffner *MCH*
Subject: Leavenworth Sewage Treatment Plant Class II Inspection,
June 12-13, 1984

Introduction

The Leavenworth Sewage Treatment Plant (STP) is an oxidation ditch-type secondary treatment plant. The facility is located alongside and discharges to the Wenatchee River (Figure 1). Discharge is regulated by National Pollutant Discharge Elimination System (NPDES) permit #WA-002097-4.

The STP was recently upgraded with funding in part coming from the Washington State Department of Ecology (WDOE) Municipal Division. Construction is complete, but operational problems continue at the plant. The primary purposes of the Class II inspection were:

1. Collect samples to compare STP performance to NPDES permit limits.
2. Identify design and operational problems at the plant.
3. Review STP laboratory and sampling procedures which included splitting composite samples for analysis by both the WDOE and STP laboratories.

Facilities at the plant include two oxidation ditches, two secondary clarifiers, and two chlorine contact basins (Figure 2). Flow is measured in a Palmer-Bowlus flume associated with the plant headworks. Wasted solids are sent to an aerated holding tank and then spread on drying beds. The dried sludge is then stored on city land.

The inspection was conducted by John Bernhardt and Marc Heffner (WDOE, Water Quality Investigations Section) and Harold Porath (WDOE, Central Regional Office). Skip Harlan (WDOE, Municipal Division) provided a pre-inspection tour. Darrel Fleischman, the STP operator, represented Leavenworth. Darrel had been operator at the plant for approximately eight months.

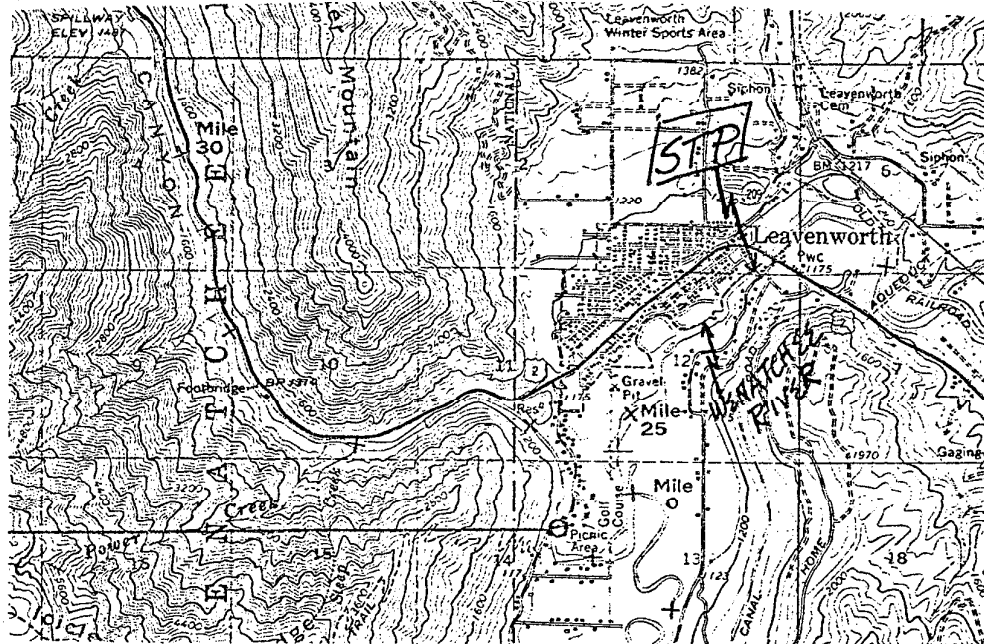
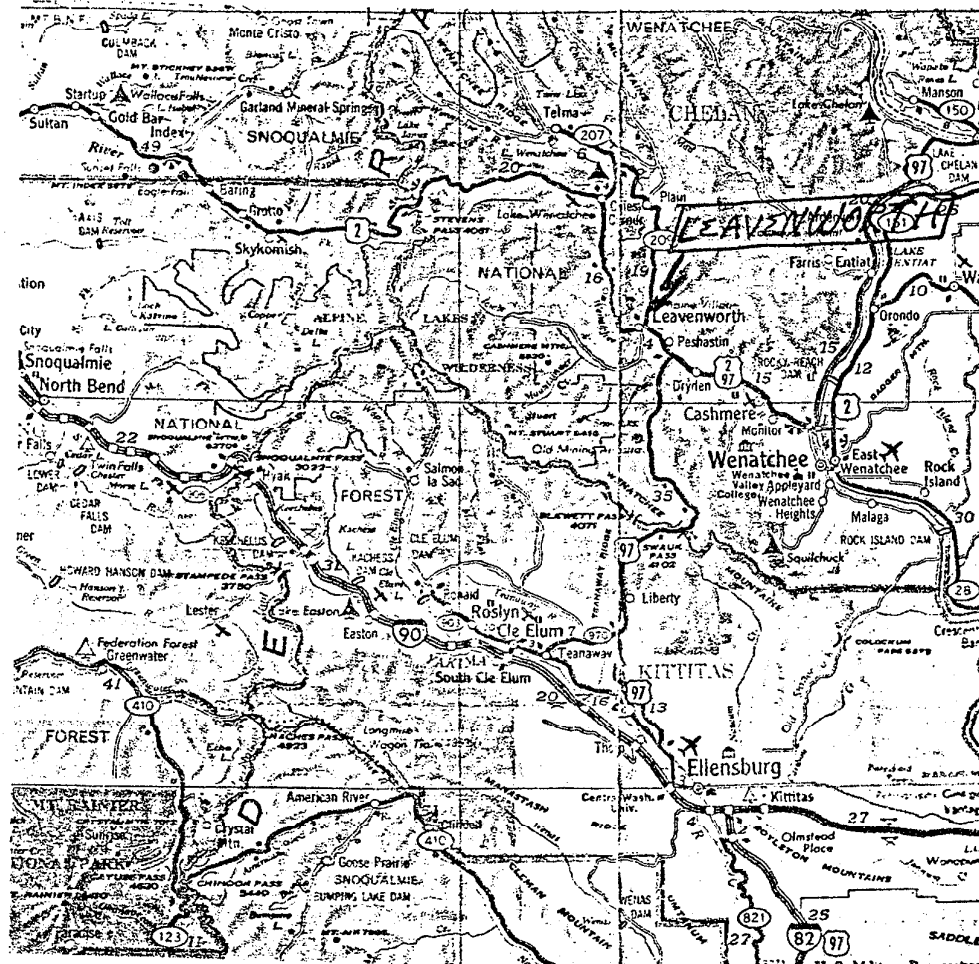


Figure 1. Leavenworth STP location map - Leavenworth, June 1984.

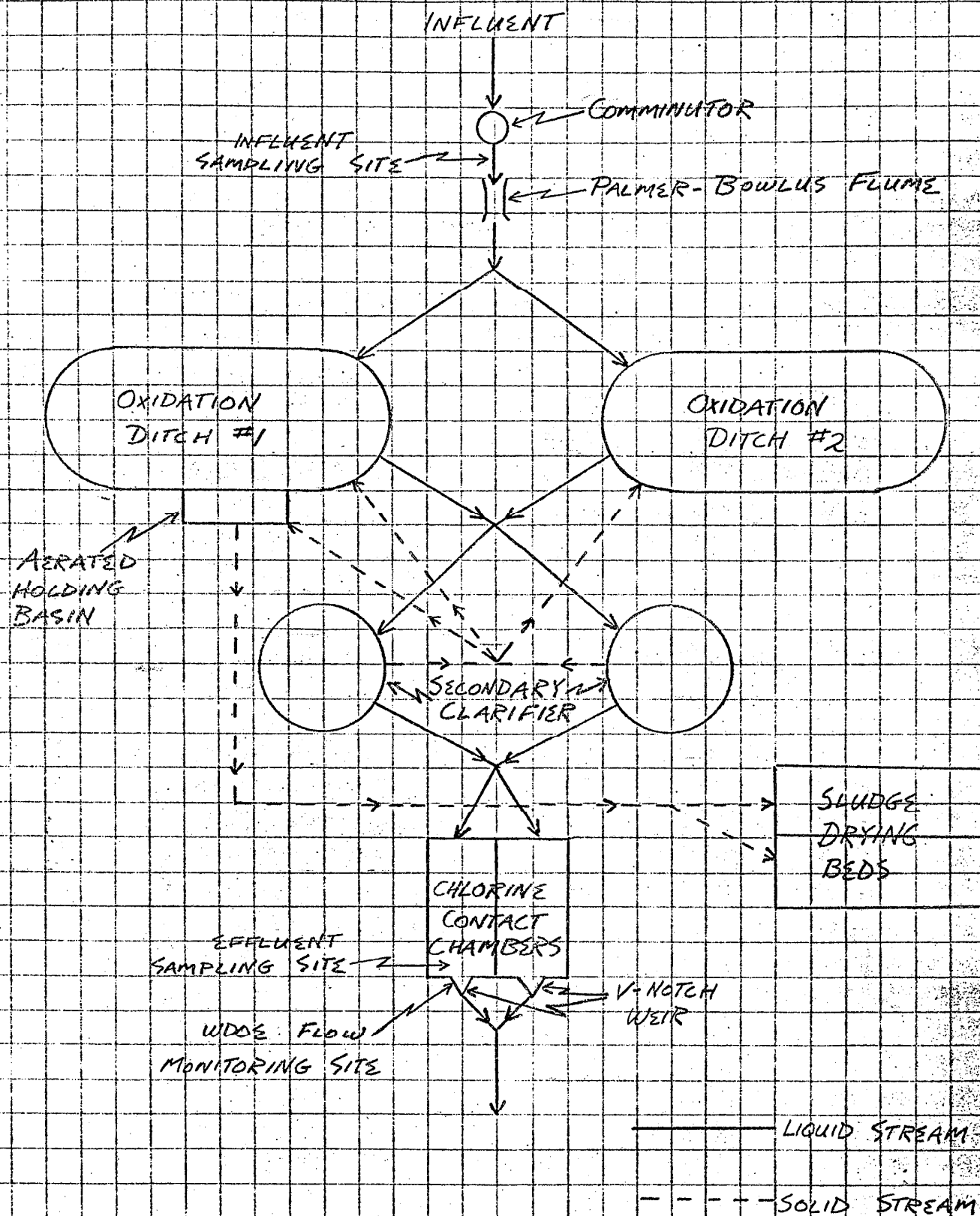


Figure 2. Flow scheme - Leavenworth, June 1984.

Procedures

WDOE and Leavenworth composite samplers were set up to collect influent and effluent samples (Figure 2). The samplers were run from approximately 0845 on June 12 to 0845 on June 13. WDOE compositors collected approximately 200 mLs of sample at 30-minute intervals while the Leavenworth samplers collected approximately 150 mLs of sample at one-hour intervals. Samples were split for analysis by both the WDOE and Leavenworth STP laboratories. Parameters tested for and results of WDOE sample analyses are presented in Table 1.

Grab samples were collected for field and laboratory analysis (Table 2). Also, a waste activated sludge sample was collected for metals analysis.

Plant flow measurements were made at a Palmer-Bowlus flume in the influent channel. Totalizer and instantaneous measurements were taken from the plant flow meter by WDOE. Also, a WDOE Manning dipper flow meter was set up in conjunction with a plant V-notch weir located at the end of the chlorine contact chamber to measure effluent flow.

Results and Discussion

Composite sampling results presented in Table 1 indicate a high-quality effluent was being discharged. BOD₅ (approximately 4 mg/L), TSS (11 mg/L), and NH₃-N (approximately 0.3 mg/L) concentrations were all low. Table 3 compares the discharge to NPDES permit limits. All limitations were met with the exception of one pH measurement (5.9) that was slightly below the lower NPDES permit limit of 6.0.

Table 3. Comparison of NPDES permit limits to WDOE analytical results - Leavenworth, June 1984.

	NPDES Permit Limits		WDOE Analytical Results	
	Weekly Average	Monthly Average	WDOE Samples	STP Samples
BOD ₅				
(mg/L)	45	30	4.8 est.	2.8 est.
(lbs/day)	126	84	13	12
% Removal		85	97	98
TSS				
(mg/L)	45	30	11	11
(lbs/day)	145	97	29	47
% Removal		85	88	90
Fecal Coliforms (#/100 mL)	400	200	5 Est.; 17 Est.*	
pH (S.U.)	6.0 ≤ pH ≤ 9.0		6.2; 5.9; 6.4*	
Flow (MGD)		0.7	0.32†	0.51††

Est. = Estimated.

* = See Table 2 for sample collection time.

† = Effluent flow measured with WDOE Manning dipper (see Table 5).

†† = Influent flow measured by plant flow meter (see Table 5).

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Table 1. Results of WDOE laboratory analysis of composite samples - Leavenworth, June 1984.

Sample	Sampler	BOD ₅ (mg/L)	Inhibited BOD ₅ (mg/L)	COD (mg/L)	Solids (mg/L)				Turbidity (NTU)	pH (S.U.)	Conductivity (umhos/cm)	Nutrients (mg/L)					Alkalinity (mg/L) as CaCO ₃	Hardness (mg/L)
					TS	TNVS	TSS	TNVS				NH ₃ -N	NO ₂ -N	NO ₃ -N	Dis-O-PO ₄ -P	T. PO ₄ -P		
Influent	WDOE Leavenworth	140		210	280	150	91	4	75	7.1	296	13	<0.10	0.20	2.8	5.8	99	50
		160		240	290	130	110	8	79	7.0	273	12	<0.10	0.20	2.5	5.0	87	54
Effluent	WDOE Leavenworth	4.8 est.	4.0 est.	39	240	160	11	1	10	6.6	292	0.20	0.10	16	5.0	5.2	13	50
		2.8 est.	2.8 est.	43	250	160	11	2	7	6.7	292	0.35	0.10	18	5.3	6.0	13	54

est. = estimated.

Table 2. Grab sample results - Leavenworth, June 1984.

Sample	Date	Time	Field Analysis					Laboratory Analysis						
			Temp. (°C)	pH (S.U.)	Conduc- tivity (umhgs/cm)	Chlorine Residual (mg/L)		D.O. (mg/L)*	Fecal Coliform (#/100 mL)	Sludge			Alka- linity (mg/L)	Alka- linity (mg/L)†
						Free	Total			MLSS (mg/L)	MLVSS (mg/L)	Percent Volatile		
Influent	6/12	0830	15.5	7.4	310									
		1515	17.4	7.2	270									
	6/13	0830	16.4	7.5	345									
		Comp	5.4	7.6	290									
Ditch 1	6/12	1015								7300	5200	71	140	72
		1515								6900	4900	71	140	70
	6/13	0835	15.4	6.4	300					7500	5300	71	130	65
Ditch 2	6/12	1015								7000	4900	70	120	58
		1515								7200	5100	71	140	78
	6/13	0845	16.2	6.3	320					7000	4900	70	120	65
Clarifier 1	6/12	1530						3.0						
	6/13	0900						3.4						
Clarifier 2	6/12	1530						2.5						
	6/13	0900						3.2						
Effluent	6/12	0845	15.4	6.2	305	<0.1	0.4							
		1530	17.3	5.9	300	0.2	0.4							
	6/13	0850	15.3	6.4	305	0.2	0.4	17 est.						
		Comp	6.1	6.5	310			5 est.						
Aerobic Holding Basin	6/12									16,000	11,200	70	410	240

*Winkler test.

est. = estimated.

†Alkalinity of sample portion filterable through a TSS test filter.

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Nitrification was occurring at the plant during the inspection ($\text{NH}_3\text{-N}$ in approximately 12 mg/L, $\text{NH}_3\text{-N}$ out approximately 0.3 mg/L, $\text{NO}_3\text{-N}$ in approximately 0.2 mg/L, $\text{NO}_3\text{-N}$ out approximately 17 mg/L). The associated alkalinity demand (approximately 85 to 120 mg/L) roughly equaled the influent alkalinity (approximately 95 mg/L). The operator had previously noted pH problems in the ditches and was adding 100 pounds of soda ash (Na_2CO_3) daily to each ditch. Adjusting soda ash dosages based on pH in the ditches appears appropriate.

Table 4 presents results of the metals analysis of sludge collected just prior to drying bed application. Metal concentrations were fairly low in comparison to sludges collected at other similar-type plants, with the exception of nickel. Nickel was found at a slightly higher concentration (62 mg/Kg, dry weight) than found in previously inspected plants (previous high 51 mg/Kg).

Table 4. Sludge metals data - Leavenworth, June 1984.

Metal	Leavenworth Sludge* (mg/Kg, dry weight)	Previously Collected Sludges**		
		Geometric Mean (mg/Kg, dry weight)	Range (mg/Kg, dry weight)	Number of Samples
Cadmium	5.9	6.9	<0.1-25	16
Chromium	25	81	37-230	16
Copper	290	326	75-1100	16
Lead	88	238	34-600	16
Nickel	62	18	<0.1-51	12
Zinc	590	1,200	165-3370	16

* = 2.1 percent solids

** = Results of sludge metals data collected during previous Class II inspections at activated sludge plants

Although the NPDES permit was being met during the inspection, several problems were noted at the plant which likely hamper continuous permit compliance. The problems included plant flow measurement, plant solids handling, chlorine contact chamber operation, and plant cleanup.

Flow measurement at the plant was made as the influent passed through a Palmer-Bowlus flume. A WDOE Manning dipper flow meter was set up in conjunction with an effluent V-notch weir in the chlorine contact chamber for comparison. The plant meter (0.51 MGD) and WDOE dipper (0.32 MGD) flow measurements did not compare well (Table 5). The cause of this discrepancy was unclear so the dipper was loaned to the operator to collect additional data (Table 6). Interesting points noted on Table 6 include:

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Table 5. Flow measurements - Leavenworth, June 1984.

Plant Meter				WDOE Dipper			
Date	Time	Totalizer Reading	Flow (MGD)	Date	Time	Totalizer Reading	Flow (MGD)
6/12	0820	5936742	0.64	6/12	0945	21099	0.35
	1325	5938086			1530	21241	0.31
	1525	5938640					
6/13	0815	5941793	0.45	6/13	0910	21626	
Flow for day			0.51	Flow for day			0.32

Table 6. Additional flow comparison data (collected and summarized by Darrel Fleischman, STP operator) - Leavenworth, June 1984.

City of Leavenworth Flow Comparison

-----TOTAL FLOW----- (MGD)				
DATE	Plant INF. Flowmtr (1)	D.O.E. Flowmtr (2)	MGD DIFF.	NOTES
8-23-84	.68	.46	.22	(2) installed at INF. flume
24	.37	.39	-.02	
25	.64	.65	-.01	
9-01-84	.72	.92	-.20	
02	.51	.68	-.17	
03	.67	.90	-.23	
04	.67	.90	-.23	
05	.63	.80	-.17	
06	.64	.79	-.15	
07	.63	.74	-.11	
08	.69	.79	-.10	
11	.62	.60	.02	
12	.62	.59	.04	
13	.66	.61	.05	
14	.61	.66	-.05	(2) secured.
25				(2) installed at EFF. weir.
26	.56	.31	.25	
27	.61	.30	.31	
28	.57	.19	.38	
10-2-84	1.90	.70	1.20	2 days' totals
6	.57	.51	.06	
8	1.41	1.41	----	2 days' totals
11	1.41	1.10	.31	" " " "
12	.51	.52	.01	
13	.61	.67	-.06	
16	.63	.33	.30	(2) calibrated, (1)
calibrated				
18	.59	.31	.28	
24	.44	.23	.21	
25	.63	.62	.01	reset fine span on (1)
26	.40	.56	-.16	(1) recalibrated
27	.49	.65	-.16	
28	.44	.54	-.10	
29	.52	.59	-.07	
30	.46	.50	-.04	
31				final calibration of (1)
11-1-84 Potable water added to system (foam control, spray. C12 injection): 110,800 gpd.				

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1. Prior to September 25, 1984, both the WDOE and plant meters were measuring flows at the influent flume. Flow measurements of less than 0.5 MGD were made only once by the plant meter and two times by the WDOE meter.
2. During the September 25, 1984 to October 17, 1984 period, the WDOE meter measured flows at the effluent weir while the plant influent measurements were made. During this period, influent flow was always >0.5 MGD, while several effluent measurements of <0.5 MGD occurred. Good correlation between both meters occurred only when WDOE effluent measurements were between 0.5 and 0.7 MGD.
3. The plant meter was recalibrated on October 17, 1984. Measurements after this date reflect the adjustment. Correlation between the two meters after recalibration was marginal.
4. In general, the effluent measurements (range approximately 0.2 to 0.7 MGD) show more daily fluctuations in flow than the influent measurements (usual range prior to calibration 0.5 to 0.7 MGD; usual range after calibration 0.4 to 0.6 MGD). Fluctuations in flow are typical in a tourist-oriented community such as Leavenworth.

The plant meter has been recalibrated, but the data seem to suggest that a more thorough check of the flume installation may be necessary. Inspection of the installation by an "expert" or routine cross-checking of the flume with the effluent weir is suggested. Without accurate flows, calculation of usable operating parameters is unlikely.

Another factor to be considered from Table 6 is in-plant potable water use incorporated into the effluent stream. The 0.11 MGD estimate noted seems high and should be checked. If accurate, the potable water flow may help explain the poor correlation between the influent and effluent flow measurements and should be considered when calculating plant efficiency and effluent characterization data for DMRs.

Table 7 compares plant capacities and loadings with WDOE design criteria. The plant operation during the inspection was characterized by a high-solids condition with a high sludge age and a high MLSS associated with a low volumetric loading and a low F:M ratio. These conditions all suggest the need for an aggressive sludge wasting program. Review of the inspection data, previous DMR data, and discussion with the operator all suggest that solids wasting capacity at the plant is a problem.

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Table 7. Comparison of oxidation ditch operating parameters to design criteria -
Leavenworth, June 1984.

	Known	WDOE Sample	STP Sample	Design Criteria	Plant Design
<u>Oxidation ditch</u>					
Total Volume (ft ³)	67,000				
(MG)	0.5				
<u>Clarifier</u>					
Surface Area (ft ²)	1,600				
Total Volume (ft ³)	16,000				
(MG)	0.12				
<u>Load to ditches</u>					
Flow (MGD)		0.32	0.51		
BOD ₅ (mg/L)		140	160		
(lbs/day)		370	680		558
<u>Operating Parameters</u>					
<u>Oxidation ditches</u>					
Detention time (hrs)		38	24	18 ≤ DT ≤ 24 [†]	
MLSS (mg/L)		7200	7900	3,000 - 8,000 [†]	
Solids Inventory					
Total (lbs)		37,000	41,000		
Volatile (lbs)		26,000	--		
F:M					
(lbs/D BOD ₅ /lbs MLSS)		0.010	0.017	0.03 - 0.10 [†]	
Sludge Age (D)		215	215	20 - 30 ^{††}	
Volumetric Loading (lbs/D BOD ₅ /1000 ft ³)		5.5	10.1	12.5 - 30 [†]	
<u>Secondary Clarifiers</u>					
Surface overflow rate (gpd/ft ²)		200	320	300 - 600 [†]	
Solids loading rate (lb/D/ft ²)		*	*	25 [†] (40,000 lbs/D)	

[†]WDOE, 1978

^{††}M & E (1979) extended aeration design parameters

*Estimations were made using the STP RAS measurement of 10,000 mg/L and an MLSS concentration of 7,500 mg/L (approximately the average of the WDOE and STP measurements). To maintain balance, a 300 percent recycle would be required. A 300 percent recycle rate would require atypical plant operation which did not occur during the inspection, so December 12, 1984, data were obtained from the operator for discussion in the text.

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Sludge wasting facilities at the plant consist of a 12,000-gallon aerobic holding basin and two sludge drying beds. System operation as described in the plant Operation and Maintenance (O&M) Manual involves concentrating solids in the holding basin then wasting the solids to the drying beds (Arvid Grant, 1981). The manual notes that cold-weather sludge digestion and drying will be limited, so solids inventory is to be reduced prior to the winter season so some accumulation in the oxidation ditches can occur while the system stays within design criteria ranges. Thus, MLSS concentrations are to be reduced during good sludge-drying weather (late spring, summer, early fall) and allowed to increase during poorer drying conditions (late fall, winter, early spring).

Shortly after the inspection the operator modified the plant operational scheme so that oxidation ditch (OD) #1 was utilized as an aerobic digester. OD #2 was used for influent treatment, with one or both secondary clarifiers used for solids removal depending on solids settleability. This operational scheme allows for more flexibility to adjust sludge concentrations in the treatment ditch (OD #2) by allowing solids to be stockpiled into OD #1 prior to final solids disposal.

Table 8 provides a rough solids balance on a monthly basis based on DMR data. The effluent data indicate that the plant is capable of producing a high-quality effluent, but that discharges exceeding the 45 mg/L weekly NPDES permit limit occur. Plant performance is marred by the periodic occurrence of substantial solids losses from the plant indicated by negative sludge generation on Table 8.

The data from Table 8 suggest that using the O&M manual operational plan that calls for winter solids accumulation in the plant is difficult at the present plant loading because:

1. The February 1, 1984, solids inventory (10,900 pounds or 2,100 mg/L MLSS) and the March 1, 1984, solids inventory (29,200 pounds or 5,600 mg/L MLSS) indicate that rapid solids growth can occur under some conditions. This suggests that a solids reduction in the fall to allow for winter accumulation may be inadequate to handle sludge generated during this time period.
2. During the July 1, 1984, to September 30, 1984, time period, effluent solids were below permit limits and the operator reported that solids wasting was maximized. During this period, the solids inventory was reduced by approximately 5,000 pounds to 26,700 pounds on September 30, 1984. This inventory compares closely with the October 1, 1983, inventory of 27,500 pounds that eventually led to the solids loss during the December 1983 to January 1984 time period. Ability of the present solids wasting facilities to reduce the solids inventory any lower prior to the onset of winter is questionable. Some additional solids reduction could be attained by wasting only digested sludge from OD #1 to the aerobic holding basin rather than mixing both WAS from the secondary clarifier and OD #1 sludge in the holding basin. Appendix A illustrates the reduction available. This reduction should be utilized when the one treatment ditch/one digester ditch operating mode is used.

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Table 8. Summary of solids inventories - Leavenworth, June 1984.

Month	Solids Inventory (lbs) [†]	Sludge Wasting (lbs) ^{††}	Sludge Generation (lbs) ^{†††}	Effluent TSS (range in mg/L)
10/01/83	27,500			
11/01/83	29,100	1,100	2,700	14-63
12/01/83	30,300	1,200	2,400	10-38
01/01/84	17,600	1,960	-10,740*	14-229
02/01/84	10,900	730	-5,970*	8-35
03/01/84	29,200	280	18,580	10-33
04/01/84	33,700	4,110	8,610	8-147
05/01/84	38,800	2,070	7,170	8-31
06/01/84	40,100	2,790	4,090	6-13
07/01/84	31,400	6,800	-1,900**	5-75
08/01/84	27,300	5,790	1,690	9-22
09/01/84	28,600	6,510	7,810	10-19
09/30/84	26,700	7,560	5,660	8-22

[†]Estimate based on average MLSS concentration and oxidation ditch + clarifier volume. After 6/30, estimate based on MLSS in OD #1 (serving as aerated digester) + OD #2 MLSS in OD #2 and both clarifiers. The operator reported that both clarifiers were used about 50 percent of the time and only one clarifier was used about 50 percent of the time during the July 1 - September 30 time period.

^{††}Estimate based on DMR data for sludge to drying beds for active wasting periods and solids sent to the aerobic holding tank for inactive wasting periods.

^{†††}Estimated sludge generation = (solids inventory at end of month) - (solids inventory at beginning of month) + (sludge wasted during month).

*Plant upset, large solids loss.

**After June 23, oxidation ditch 1 operated as aerobic digester, some solids loss over weir.

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Several factors should be considered in determining if using one of the ditches as a digester is a long-term solution to the solids problem. Potential problems that should be considered include the ability of the rotors to maintain an adequate dissolved oxygen (D.O.) concentration in OD #2, a freeze hazard associated with the large aerobic digester (OD #1) during winter conditions, and the threat of solids accumulations in OD #1 that exceed the rotors' mixing capabilities.

A possible plan for evaluating the capabilities of the system as it is now being operated is presented in Figure 3. The method suggested need not be followed, but as a minimum, data should be collected to answer the following questions:

1. What is the plant organic loading?
2. What is the sludge yield?
3. Can OD #1 serve as an aerobic digester throughout the winter? If so, with sludge volume reduction in OD #1 and wasting only from OD#1 to the holding basin, can an ever-increasing solids inventory be avoided? Study of seasonal solids inventories will be necessary to evaluate the ability of the plant to dispose of solids at a rate greater than or equal to the solids generation rate.

With answers to these questions, plant capacity and in-plant sludge handling needs can be reasonably assessed and a long-term operating strategy developed. Final disposal of the dried sludge should also be addressed. The operator reported that presently dried sludge is stored on city land awaiting development of a disposal plan. The plan should be developed and instituted.

Another solids problem noted in the comparison of the plant flow to design criteria was the clarifier solids loading capacity (Table 7). Calculations based on inspection data indicated a high recycle rate (300 percent) was required to maintain the MLSS concentration in the oxidation ditches. Because the recycle rate was not checked, current data were requested from the operator so the recycle rate could be checked (Table 9). The MLSS data balanced reasonably, suggesting that the data were accurate. The clarifier solids loading for the December 12 data was approximately 26 lbs/ft²/D, slightly above the WDOE design criteria of 25 lbs/ft²/D. During the inspection, the clearwater depth in the clarifiers was approximately 7.5 feet, suggesting that there was not a clarifier overload problem at that time.

Figure 4 illustrates the relationship between the MLSS concentration and the flow the clarifiers could handle staying within the WDOE criteria. Judging from both the loading and operator's concerns about clarifier solids loss, any increases in MLSS concentration without corresponding decreases in total flow to the clarifiers should be avoided. A reduction in the MLSS concentration may decrease the probability of higher flows causing solids loss from the clarifier.

Assure that the plant flow meter is working properly.

Try to operate the plant using OD #1 as an aerobic digester during the winter period. Provision should be made to prevent freeze damage to OD #1, and the plan instituted if freezing appears imminent.

OD #1 does not freeze

Continue to operate in the present mode. Sludge from OD #2 should be wasted to OD #1 as necessary to prevent solids overflow from the clarifiers.

wastewater treatment adequate

Wasting directly from OD #1 to the aerated holding tank should be used exclusively. Sludge yield and treatment design information should be used in evaluating capacity available in this mode of operation. The sludge yield/wasting capabilities should be evaluated through the summer to assure that the sludge inventory will not be increasing continuously. If wasting capacity is inadequate, additional capacity should be added.

wastewater treatment inadequate

Use of one OD as an aerobic digester should be discontinued. Increase sludge wasting capacity so both OD #1 and OD #2 can treat the influent flow. Sludge handling facilities should be sized so a suitable MLSS concentration can be maintained throughout the year.

solids resuspension unfeasible

Use of one OD as an aerobic digester should be discontinued. Sludge handling facilities should be sized so a suitable MLSS concentration can be maintained throughout the year.

solids resuspension feasible

Wasting directly from OD #1 to the aerated holding tank should be used exclusively. Sludge yield and treatment design information should be used in evaluating capacity available in this mode of operation. The sludge yield/wasting capabilities should be evaluated through the summer to assure that the sludge inventory will not be increasing continuously. If wasting capacity is inadequate, additional capacity should be added.

wastewater treatment adequate

After the spring thaw, try to resuspend the solids in OD #1. Ease of resuspension and other thaw-related problems (ex. odors) can be used to appraise whether this is a viable alternative.

solids resuspension feasible

Provision for a more adequate winter solids wasting system should be made.

solids resuspension feasible

Use of one OD as an aerobic digester should be discontinued. Sludge handling facilities should be sized so a suitable MLSS concentration can be maintained throughout the year.

wastewater treatment inadequate

After the spring thaw, try to resuspend the solids in OD #1. Ease of resuspension and other thaw-related problems (ex. odors) can be used to appraise whether this is a viable alternative.

solids resuspension unfeasible

Use of one OD as an aerobic digester should be discontinued. Increase sludge wasting capacity so both OD #1 and OD #2 can treat the influent flow. Sludge handling facilities should be sized so a suitable MLSS concentration can be maintained throughout the year.

Determine cause

solids wasting problem

inadequate treatment capacity

Plan 2

Hold excess sludge in OD #2, wasting as possible to the holding tank/drying bed facilities.

Plan 1

Drop the level in OD #1 as part of the freeze damage prevention program. Waste sludge to OD #1 making sure damage to internal structure is avoided as the ice level rises.

OD #1 freezes or cannot be wasted to

Decide on a sludge wasting plan for OD #2

Figure 3. OD #1 long-term use as an aerobic digester consideration - Leavenworth, June 1984.

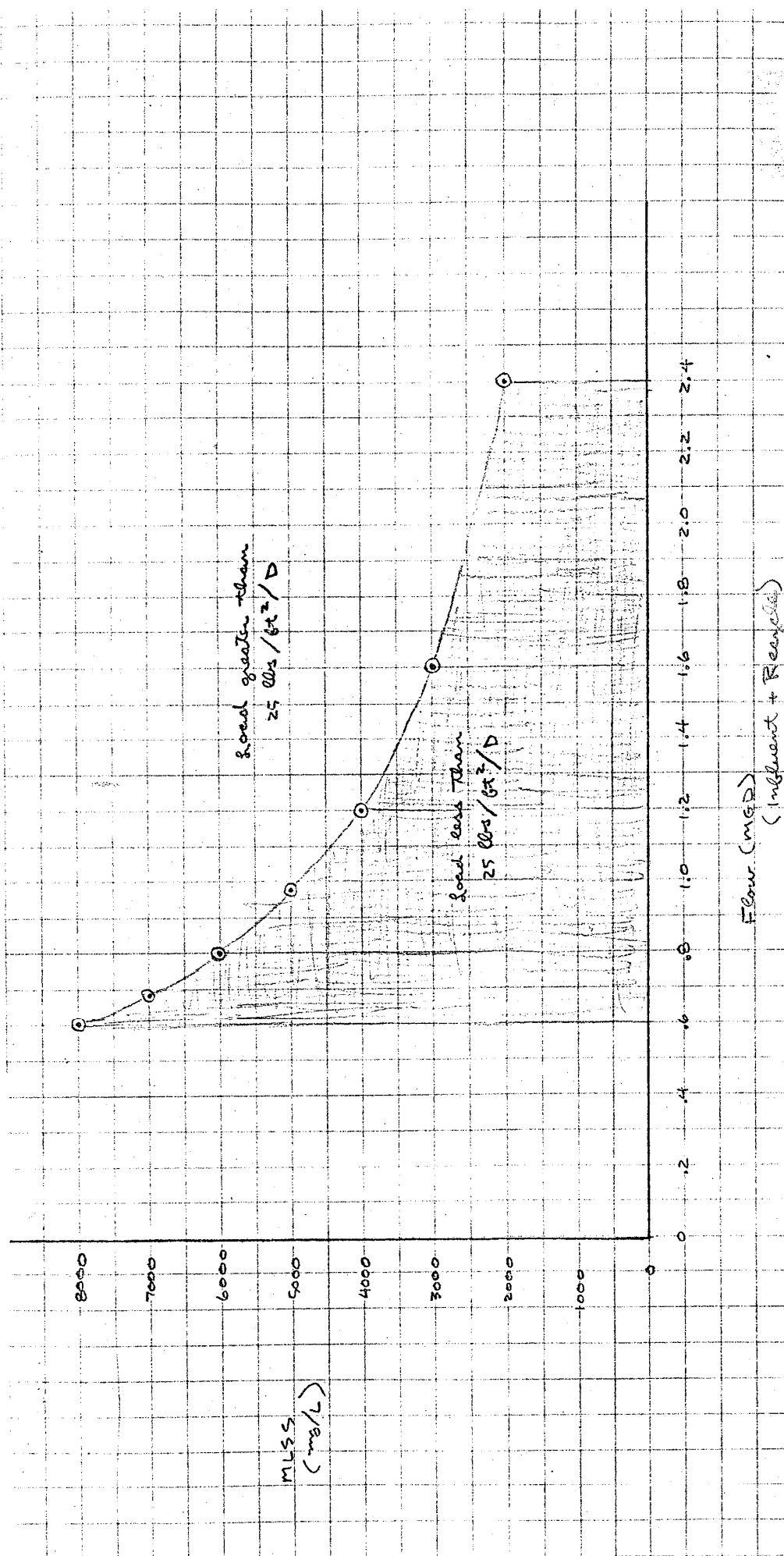


Figure 4. Flow and MLSS concentrations allowing clarifier solids loading to remain under 25 lbs/ft²/D
 - Leavenworth, June 1984.

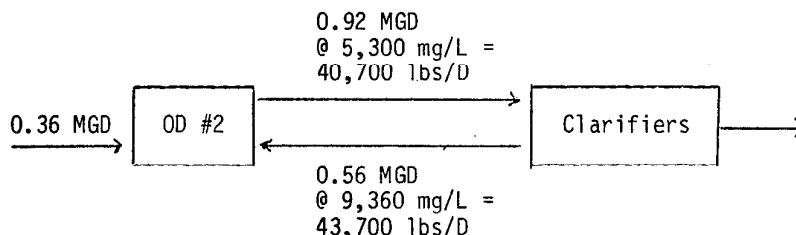
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Table 9. December 12, 1984, solids data analysis* - Leavenworth, June 1984.

Plant Operational Data*

Sludge recycle	- 0.56 MGD (based on telescopic valve settings with both clarifiers being used)
MLSS (OD #2)	- 5,300 mg/L
RAS	- 9,360 mg/L
Plant influent flow	- 0.36 MGD

Mass Balance



*Data reported by Leavenworth operator.

The chlorine contact chamber problem consists of solids both settling and floating in the chlorine contact chamber. Sludge depth measurements in the operating contact chamber ranged from 0.75 to 1.25 feet, while those in the out-of-service chamber ranged from 0.75 to 4.5 feet. The operator reported that the chamber in service had been in service less than a week, suggesting that sludge accumulation is fairly rapid. The contact chamber also had a severe floating scum problem. A long-term solution to these problems would involve experimentation with reduced sludge age and reduced clarifier solids loading in an attempt to get more complete solids capture in the clarifiers. Also, reduction of any influent grease loading may help reduce the floating scum problem. As a temporary measure, a scum trough had been installed just upstream of the outlet weir and seemed to be preventing continuous scum discharge. When the scum trough was turned for discharge, the scum trough flow went through a coarse filter then into the effluent. Discharge from the trough should be monitored for total suspended solids (TSS) concentration, and if the concentration is greater than the weekly limit (45 mg/L), the filter should be modified to meet the limit, or the scum rerouted back into the plant treatment train.

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Routine process unit cleanup appeared to be lacking, although the operator was observed cleaning. The operator reported that the plant cleaning water plumbing was one-inch diameter to within a couple feet of the outlet and was then reduced to three-fourths-inch diameter. He attributed poor water pressure for cleaning to this reduction in size. The constriction should be removed in order to maximize available pressure.

Laboratory Review

Laboratory procedures at Leavenworth were generally very good. Table 10 presents analytical results from samples split for both WDOE and STP analysis. Comparisons are acceptable for all composite splits. Fecal coliform grab sample analytical results did not compare closely (WDOE result: 5 estimated/100 mL; Leavenworth result: 101/100 mL). The reason is unclear, but given the operator's extensive experience with the fecal coliform test and possible variation between grabs, this discrepancy could be due to sample differences, not analytical differences, and therefore is not of great concern. Several minor problems were noted, however, which should be corrected:

Table 10. Comparison of WDOE and Leavenworth laboratory results - Leavenworth, June 1984.

Sample	Sampler	BOD ₅ (mg/L)		TSS (mg/L)		Fecal Coliform (#/100 mL)	
		WDOE	Leavenworth	WDOE	Leavenworth	WDOE	Leavenworth
Influent	WDOE	140	146	91	98		
	Leavenworth	160	149	110	123		
Effluent	WDOE	4.8*	11	11	10		
	Leavenworth	2.8*	9	11	10		
	Grab					5*	101

*Estimated

Sample Collection - Composite samples should be cooled during collection (preferably to 4°C). The Leavenworth effluent composite samples were approximately 12°C at the end of the collection period. Provision should be made for better sample cooling.

BOD₅ Testing

1. Distilled water used for making dilution water should be stored approximately one week in the dark prior to use. Nutrients should be added to the stored water approximately one hour before use as dilution water.

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2. When the pH of the effluent sample is below 6.5, the sample should be adjusted to pH 7 with 0.1 N or 1 N NaOH before the test (WDOE, 1977, pH).
3. D.O. measurements, using both the meter and Winkler methods, of samples in the 2 to 4 mg/L concentration range should be run occasionally to assure meter calibration over the entire scale.

TSS Testing

1. Filters should be pre-rinsed prior to sample test use.
2. Sample filtering time should always be less than five minutes. If filtering is not complete within five minutes, the filter should be considered plugged, and be discarded. A lesser volume of the same sample should then be run using a new filter.
3. An accurate thermometer should always be in place to monitor drying oven temperature. The temperature should be checked before drying.

Conclusions

The plant was operating well within NPDES permit limits during the inspection except for one effluent pH measurement. Data collection, visual observations, and discussions with the operator identified several problem areas that could prevent continued permit compliance. These included:

1. Flow data generated at the plant have been of questionable accuracy, making calculation of operational parameters equally questionable. The meter has been recalibrated, but additional checks to assure that the flume is not the source of error are suggested. Also, if the operator's 0.11 MGD estimate of potable water added to the flow within the plant is accurate, DMR data should be adjusted to reflect this contribution.
2. Solids wasting facilities did not appear adequate for good plant operation throughout the year. A need for wasting throughout the year rather than at a high rate during the summer and low rate during the winter is apparent. The operator has modified the plant flow scheme (using OD #1 as an aerobic digester), neutralizing the solids accumulation problem for an undetermined time period. Appropriate data collection to answer questions noted in the text will help identify how long this operational modification can be used. Also, a disposal system for the dried sludge is needed.
3. Clarifier solids loading approximated the WDOE design loading criteria. Flow to the clarifier (influent + recycle) and MLSS concentration should be monitored to avoid clarifier overloads.

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4. Chlorine contact chamber solids accumulation appeared to be occurring fairly quickly. Modification of the chlorine scum trough to prevent scum from escaping out the effluent line may be necessary.
5. Plant clean-up water may lack adequate pressure to be effective. Plumbing should be checked to see if the line constrictions the operator mentioned can be eliminated.

Attention to these problem areas should prove useful in making long-term operational plans that will result in a consistently high-quality effluent.

Laboratory and sampling procedures were generally very good. Recommendations for improvements in some areas are noted in the discussion.

MC:cp

Attachments

REFERENCES

- Arvid Grant and Associates, Inc., Consulting Engineers, 1981. Leavenworth Wastewater Treatment Plant Operation and Maintenance Manual, May 1981.
- Metcalf and Eddy, Inc., 1979. Wastewater Engineering: Collection, Treatment, Disposal, McGraw-Hill.
- State of Washington, Department of Ecology, 1977. Laboratory Test Procedure for Biochemical Oxygen Demand of Water and Wastewater, DOE 77-24, August, 1977, Revised February 1983.
- State of Washington, Department of Ecology, 1978. Criteria for Sewage Works Design, February 1978, Revised March 1980.

Appendix A.

Importance of wasting from OD #1 when using it as an aerobic digester -
Leavenworth, June 1984.

Problem:

100 lbs of solids in OD #2 are to be wasted.

If the solids are wasted directly to the drying bed, wasteage would be:

% TVSS - 76% (Sept. 1984 DMR average)

% TNVSS - 24%

TSS wasting - 100 lbs

TNVSS wasting - 24 lbs

TVSS wasting - 76 lbs

If the solids were sent to the holding basin/aerobic digester first,
wasteage would be:

% TVSS - 73% (Sept. 1984 DMR average)

% TNVSS - 27%

Because digestion reduces only the volatile fraction, TNVSS
wasting would remain the same:

TNVSS wasting - 24 lbs

Then:

$$\frac{24 \text{ lbs TNVSS}}{x \text{ lbs TSS}} = 27\% \quad x = 89 \text{ lbs TSS}$$

TSS wasting = 89 lbs

TVSS wasting = 65 lbs

So TSS wasting is reduced by 11 lbs.

If the solids were sent to OD #1 first, wasteage would be:

% TVSS - 68% (Sept. 1984 DMR average)

% TNVSS - 32%

Because digestion reduces only the volatile fraction, TNVSS wasting
would remain the same:

TNVSS wasting - 24 lbs

Then:

$$\frac{24 \text{ lbs TNVSS}}{x \text{ lbs TSS}} = 32\% \quad x = 75 \text{ lbs TSS}$$

TSS wasting = 75 lbs

TVSS wasting = 51 lbs

So TSS wasting is reduced by 25 lbs.